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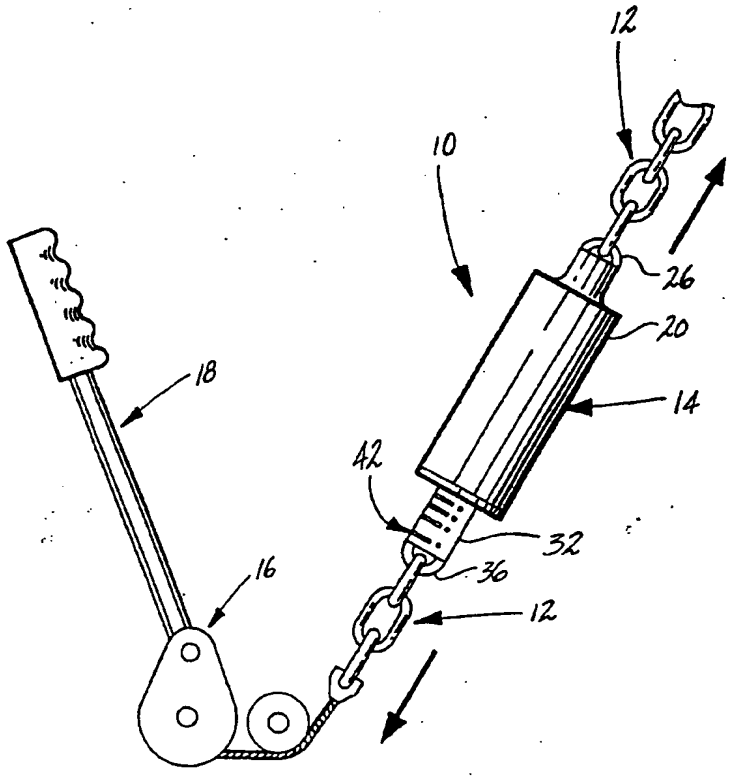
(54) Title: TIE-DOWN CHAIN WITH AN INTEGRAL TENSION INDICATOR

(57) Abstract

A tension indicator (14) is interposed as a link into a tie-down chain (12) for attaching an automobile to a car carrier. The tension indicator (14) comprises a housing (20), a plunger (28) inside the housing (20), a biasing means (38, 44, 52, 54) for biasing the plunger (28) away from a wall (22) of the housing (20) and an indicating means (42) for indicating the magnitude of the load on the tie-down chain (12). The biasing means (38, 44, 52, 54) may comprise an elastomeric material (38), a helical spring (52), a Belleville spring (44) or any other suitable biasing means (54).



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TIE-DOWN CHAIN WITH AN INTEGRAL TENSION INDICATOR

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to automobile tie-down chains, and more particularly, to automobile tie-down chains incorporating a tension measuring device.

State of the Prior Art

Truck semitrailer and railroad car carriers are often used to transport automobiles, such as from the automobile factory to individual dealerships. The automobiles being transported are fastened to the car carrier by means of tie-down chains. Typically, one tie-down chain is attached at each of the four corners of the automobile, and runs between a location on the car carrier and an opposing location on the automobile's frame. The tie-down chains are tightened to a predetermined tension designed to overcome the potential energy of the automobile's suspension system.

Due to the rigors of travel over unknown and sometimes rough road conditions, it is imperative that the automobile be restrained from undue movement during transportation. Bouncing of the automobiles on the car carrier can cause excessive stresses in the tie-down chains which are transmitted to the frame of the automobile. Bouncing motions of the automobile allow the automobile to build momentum relative to the car carrier. As the automobile reaches the end of its travel, the chain tightens imposing large forces upon the automobile's frame. Therefore, it is desirable that the automobile tie-down chains be tensioned to a sufficient degree to prevent undue movement of the automobile relative to the car carrier during transportation.

Springs and shock absorbers have been used in the past to dampen the force swings in tie-down chains. For instance, the U.S. Patent No. 2,227,870 to Thomas, issued January 7, 1941, discloses a method for loading trucks to a railway car. The anchoring means disclosed comprises a chain, attached at one end to the truck axle and at the opposite end to the railroad car by means of a spring loaded hold down member. The hold down

member is interposed between the end of the chain and a mounting clevis in the railroad car bed.

U.S. Patent No. 3, 140,850 to Packard, issued July 14, 1964, discloses an adjustable tie-down chain for securing vehicles such as trucks and the like in place on railroad cars and the like for transportation. The tie-down chain has an interposed snubber to absorb the shocks of traveling. The snubber comprises two U-bolts which are disposed in the assembly on a common axis with the legs directed toward one another and in crossing planes adapted to serve as links of the tie-down chain. The distal end of the legs of each U-bolt are attached to a compression disk. A rubber compressible member is interposed between the compression disks, such that tension on the chain pulls the two compression disks together to compress the compressible member, dampening peak stresses in the chain.

Proper tensioning of each chain is important for safe transportation of the automobile. Too little tension in the tie-down chains is harmful as it allows the transported automobile to bounce up and down on the car carrier possibly over stressing the tie-down chains or the automobile frame. If the chains are tensioned too tightly, they may exceed the designed stresses of the automobile's frame. Uneven tensioning of the different chains holding down a single automobile also imposes excessive stresses on the automobile frame.

The conditions under which automobiles are typically loaded onto car carriers can make proper tensioning of the tie-down chains difficult. Often a large number of cars must be loaded quickly. After a car is properly positioned on the car carrier, each tie-down chain is attached to the automobile's frame and tightened by means of a ratcheting winch. Generally, the winch has large increments of force in between each ratchet position making fine adjustments of the chain tension difficult. After a chain is tightened by the winch, a measuring device is sometimes applied to the chain to determine its tension. If the tension is within the designed limits, the next chain may then be tensioned. Often, the personnel loading the automobiles fail to use any tension measuring device, and apply tension to the chains solely by their subjective feel of force on the ratchet handle. The ratchets have a high enough gear ratio that tensions greatly exceeding the automobile's design

parameters may easily be applied to the tie-down chains. Even if the tension measuring device is employed, a careless operator may first grossly over tighten the ratchet before measuring the tension.

The external tie-down chain tension measuring device is inconvenient to use, making it less likely that it would actually be used. A measuring device incorporated into the links of the tie-down chain would always be readily at hand, making it likely that an operator would refer to the tension measuring device while tightening the ratchet.

Overload indicators have been used in lifting chains. For instance, U.S. Patent No. 4,102,295 to Crook Jr. et al., issued July 25, 1978, discloses an overload indicator for interposing between a load lifting chain and a load lifting hook. The overload indicator comprises a hollow cylindrical housing, a plunger assembly operating inside the housing, and a biasing means, such as a spring, biasing the plunger away from one end of the housing. As the load on the loading hook is increased beyond the force of the biasing means, an indicating band becomes visible through an opening in the side wall of the housing, thus indicating that the maximum load has been achieved.

Tie-down chains have been used for many years to fasten automobiles to car carriers, yet the external tension measuring device is still the standard for ensuring proper chain tension. Careless operators continue to over tighten tie-down chains thus stressing the automobile's frame, or leave the chains too loose so that jarring motions of travel stress the automobile's frame.

SUMMARY OF INVENTION

The present invention provides an easy means for checking the magnitude of tension applied to the chains during the tensioning process, increasing the likelihood that the operator will actually measure the tension and apply the correct tension. Also, the present invention measures the tension as it is applied to prevent over-tensioning prior to tension measurement.

In accordance with the invention, a tie-down apparatus ties a transport object to a transport vehicle at multiple locations, by applying a uniform predetermined holding force to the transport object at each location.

The tie-down apparatus has at least one tether having a first end and a second end, with the first end being attachable to the transport object and the second end being attachable to the transport vehicle. Each tether integrally includes a tension indicator which comprises a first end and a second end, a biasing means biasing the first end relative to the second end, and indicia on one of the first or second ends of the tension indicator indicating a relative location of the first end of the tension indicator to the second end of the tension indicator for indicating a predetermined magnitude of tension on the tether. When the tethers are attached to the transport object and transport vehicle respectively, and the indicia indicate that the predetermined tension has been achieved in the tethers, the uniform predetermined holding force is applied to the transport object at each location where the tethers attach.

The indicia preferably comprise visual markings on a portion of the first or second ends. The markings can indicate the tension in the tether in force units such as pounds or kilograms.

Preferably, the first end of the tension indicator comprises a housing, having walls at its first and second ends. The second end of the tension indicator comprises a plunger having a head disposed within the housing and a stem connected to the head extending outwardly from the second end wall of the housing. The biasing means biases the head away from the second end wall of the housing.

The biasing means can be an elastomeric material disposed between the head and the second end wall of the housing. Alternatively, the biasing means can be a helical compression spring disposed between the head and the second end wall of the housing. The biasing means can be a Belleville spring disposed between the head and the second end wall of the housing.

In accordance with the invention, a tie-down apparatus for securing a vehicle to a vehicle carrier at a predetermined holding force. The tie-down apparatus includes a housing having a first end wall and an opposite second end. The second end defines an opening. A plunger is disposed within the housing for reciprocal movement therein, and has a shaft extending outwardly of the housing through the opening. A biasing means is disposed within the housing in a position to bias the plunger toward the first end wall.

A first connecting means on the first end wall connects the first end wall to a vehicle. A second connecting means on the second end connects the second end to a vehicle carrier. An indicium on the shaft is in a position to be visible outside of the housing only when the plunger is moved away from the first wall a sufficient distance so that the force on the biasing means is equivalent to the predetermined holding force. When the first connecting means is attached to a vehicle, the second connecting means is attached to a vehicle carrier, and increasing force is applied against the biasing means, the vehicle will be secured to the vehicle carrier at the predetermined holding force when the indicium becomes visible.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a side elevational view of a tensioning ratchet and automobile tie-down chain according to the invention incorporating a tension indicator;

FIG. 2 is a sectional view of a first embodiment of a tension indicator according to the invention, employing an elastomeric substance as a biasing means;

FIG. 3 is a sectional view of a second embodiment of a tension indicator according to the invention, employing a Belleville spring as a biasing means;

FIG. 4 is a sectional view of a third embodiment of a tension indicator according to the invention, incorporating a helical compression spring as a biasing means; and

FIG. 5 is a sectional view of a fourth embodiment of a tension indicator according to the invention employing a coil spring as a biasing means.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the drawings, and to FIG. 1 in particular, a tie-down chain 10, according to the invention, generally comprises standard interlocking chain links 12 having a tension indicator 14 incorporated into the

chain 10 as a link. The tie-down chain 10 is tightened by means of a ratchet 16 having a ratchet handle 18. The tension indicator 14 is directly in view of an operator (not shown) operating the ratchet 16. The operator is thus likely to reference the tension indicated by the tension indicator 14 to properly tension the chain. The properly tensioned chain 10 holds a transported automobile safely to a car carrier (not shown), avoiding unnecessary stresses to the frame of the automobile.

Turning to FIG. 2, a preferred embodiment of the tension indicator 14 according to the invention comprises a housing 20, having a first end 22 and a second end 24, the first end 22 being closed and having a ring 26 extending outwardly axially therefrom, a plunger 28 disposed within the housing 20 having a head 30 adapted to be received within the housing 20, and a stem 32 extending axially from the head 30 outwardly through an opening 34 in the second end of the housing 20. A second ring 36 is provided on the outer end of the plunger stem 32 for interconnection to the chain links 12. The space between the plunger head 30 and the second end 24 of the housing 20 is filled with an elastomeric material 38 which biases the plunger head 30 away from the second end of the housing 24. The housing 20 can have any cross-sectional shape, such as circular or square, but preferably has straight walls 40 to provide a guiding surface for the head of the plunger 30. A series of tension indicating marks are inscribed about the circumference of the plunger stem 32 and their alignment with the second end opening 34 provides a visual indication of the load applied between the rings 26, 36.

Several schemes may be employed for indicating a proper tension in the chain 10. For instance, the tension indicating marks 42 may be scaled in pounds or other force units to indicate the magnitude of the tension. For simplicity, the tension indicator 14 may be provided with more limited markings to indicate only the information the operator requires to properly tension the chain 10. The tension indicating marks 42 may be limited to showing a condition of no load, a proper tension for a small car, and a proper loading for a large car. The tension may be indicated by a color coding scheme, symbols, or words. In the preferred embodiment, a combination of colors and wording is preferred.

FIG. 3 illustrates a second embodiment of the tension indicator 14 according to the invention. The second embodiment is similar in all respects to the first embodiment of the invention but substitutes a Belleville spring 44 for the elastomeric material 38 to bias the plunger head 30 away from the housings second end 24. The Belleville spring 44 comprises a series of disklike, low-height, truncated cones 46 of spring metal stacked one atop the other in alternating orientation. Each Belleville cone 46 has a broad base 48 and a narrower truncated apex 50. The cones 46 are arranged so that the base 48 of one cone 46 contacts the base 48 of an adjacent cone 46.

FIG. 4 illustrates a third embodiment of the tension indicator 14 according to the invention. The third embodiment of the tension indicator 14 is similar to the first two embodiments except that a helical compression spring 52 biases the plunger head 30 away from the housing second end 24. The helical compression spring 52 is disposed between the plunger head 30 and the housing second end 24 with the plunger stem 32 passing coaxially through its coils.

FIG. 5 illustrates a fourth embodiment of the tension indicator 14 according to the invention. The fourth embodiment of the tension indicator 14 also employs a helical compression spring 54. The compression spring 54 is caged within a series of J-hooks 56 running coaxially through the coils of the spring 54. Each J-hook 56 comprises an elongated shaft 58 running coaxially inside the coils of the compression spring 54, a spring hook 60 curving outwardly and upwardly from one end of the shaft portion 58 to engage and hold an end 62 of the helical spring 54, and a retaining hook at an opposite end of the J hook shaft 58. The spring end section 60 of two J-hooks 56 engage one spring end 62 and two additional J-hooks 56 engage the opposite spring end 62. Thus, as the retaining hook portion 54 of the opposing J-hooks 56 are pulled apart, the helical compression spring 54 is compressed.

The adjacent retaining hook section 64 of two similarly aligned J-hooks 56 may be connected at their ends to form a ring 66. The ring 66 may be connected into a link 12 in the load indicating chain 10, or may engaged a bulk head 68, internal to the tension indicator 14, as indicated in FIG. 5. The remaining hook section 64 at the opposite end of the helical

compression spring 54 can engage the head 30 of the plunger 28. Also, the second end opening 34 may have an axial collar 70 extending therefrom having a window 72 radially looking into the load indicator markings 42 on the plunger stem 32.

Reasonable variation and modification are possible within the scope of the foregoing disclosure and drawings without departing from the spirit of the invention, as defined in the accompanying claims. For instance, any number of biasing means may be employed, such as extension springs, torsion springs, etc. Also, the invention is not limited to any particular indicating means and may be employed without a housing. The tension indicator 14 is shown in FIG. 1 incorporated as a link into the middle of a chain 10 composed of individual links 12. Other arrangements are possible within the spirit of the invention. For instance, the chain 10 may comprise a stranded wire or woven fabric tether, and the tension indicator 14 may be located at one end of the chain 10.

CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A tie-down apparatus for tying a transport object to a transport vehicle at multiple locations, by applying a uniform predetermined holding force to the transport object at each location, the apparatus comprising:

at least one tether having a first end and a second end, the first end being attachable to the transport object and the second end being attachable to the transport vehicle;

each tether integrally including a tension indicator comprising:

a first end and a second end;

a biasing means biasing the first end relative to the second end; and

indicia on one of the first or second ends of the tension indicator indicating a relative location of the first end of the tension indicator to the second end of the tension indicator for indicating a predetermined magnitude of tension on the tether;

whereby when the tethers are attached to the transport object and transport vehicle respectively, and the indicia indicate that the predetermined tension has been achieved in the tethers, the uniform predetermined holding force is applied to the transport object at each location where the tethers attach.

2. A tie-down apparatus according to claim 1 wherein the indicia comprise visual markings on a portion of the first or second ends.

3. A tie-down apparatus according to claim 2 wherein the markings indicate the tension in the tether in force units such as pounds or kilograms.

4. A tie-down apparatus according to claim 1 wherein:

the first end of the tension indicator comprises a housing, the housing having walls at a first and second end thereof;

the second end of the tension indicator comprises a plunger having a head disposed within the housing and a stem connected to the head extending outwardly from the second end wall of the housing; and

the biasing means biases the head away from the second end wall of the housing.

5. A tie-down apparatus according to claim 4 wherein the biasing means comprises elastomeric material disposed between the head and the second end wall of the housing.

6. A tie-down apparatus according to claim 4 wherein the biasing means comprises a helical compression spring disposed between the head and the second end wall of the housing.

7. A tie-down apparatus according to claim 4 wherein the biasing means comprises a Belleville spring disposed between the head and the second end wall of the housing.

8. A tie-down apparatus for securing a vehicle to a vehicle carrier at a predetermined holding force comprising:

a housing having a first end wall and an oppositely disposed second end, said second end defining an opening,

a plunger disposed within the housing for reciprocal movement therein, said plunger having a shaft extending outwardly of the housing through the opening,

biasing means disposed within the housing in a position to bias the plunger toward the first end wall,

a first connecting means on the first end wall for connecting the first end wall to a vehicle,

a second connecting means on the second end, for connecting the second end to a vehicle carrier, and

an indicium on the shaft in a position to be visible exterior of the housing only when the plunger is moved away from the first wall a sufficient distance so that the force on the biasing means is equivalent to the predetermined force, whereby when the first connecting means is attached to a vehicle, the second connecting means is attached to a vehicle carrier, and increasing force is applied against the biasing means, the vehicle will be secured to the vehicle carrier at the predetermined holding force when the indicium becomes visible.

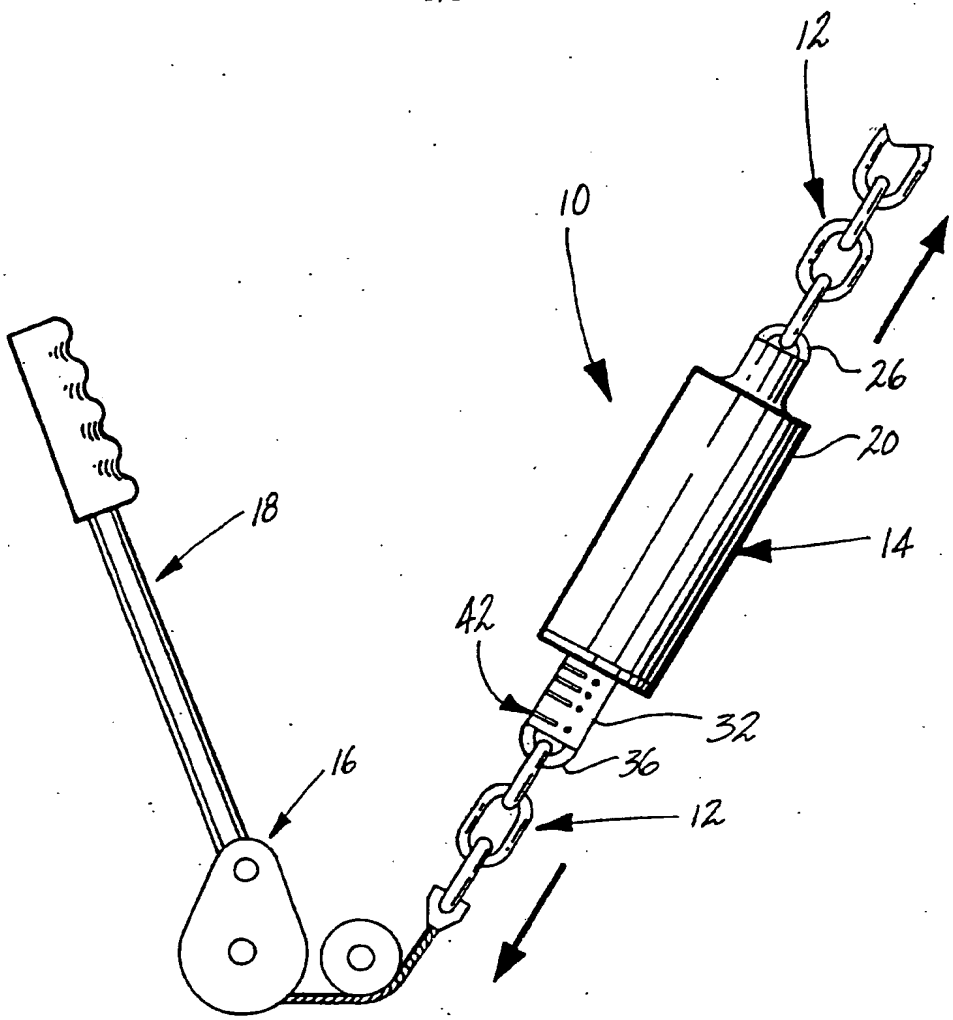

FIG. 1

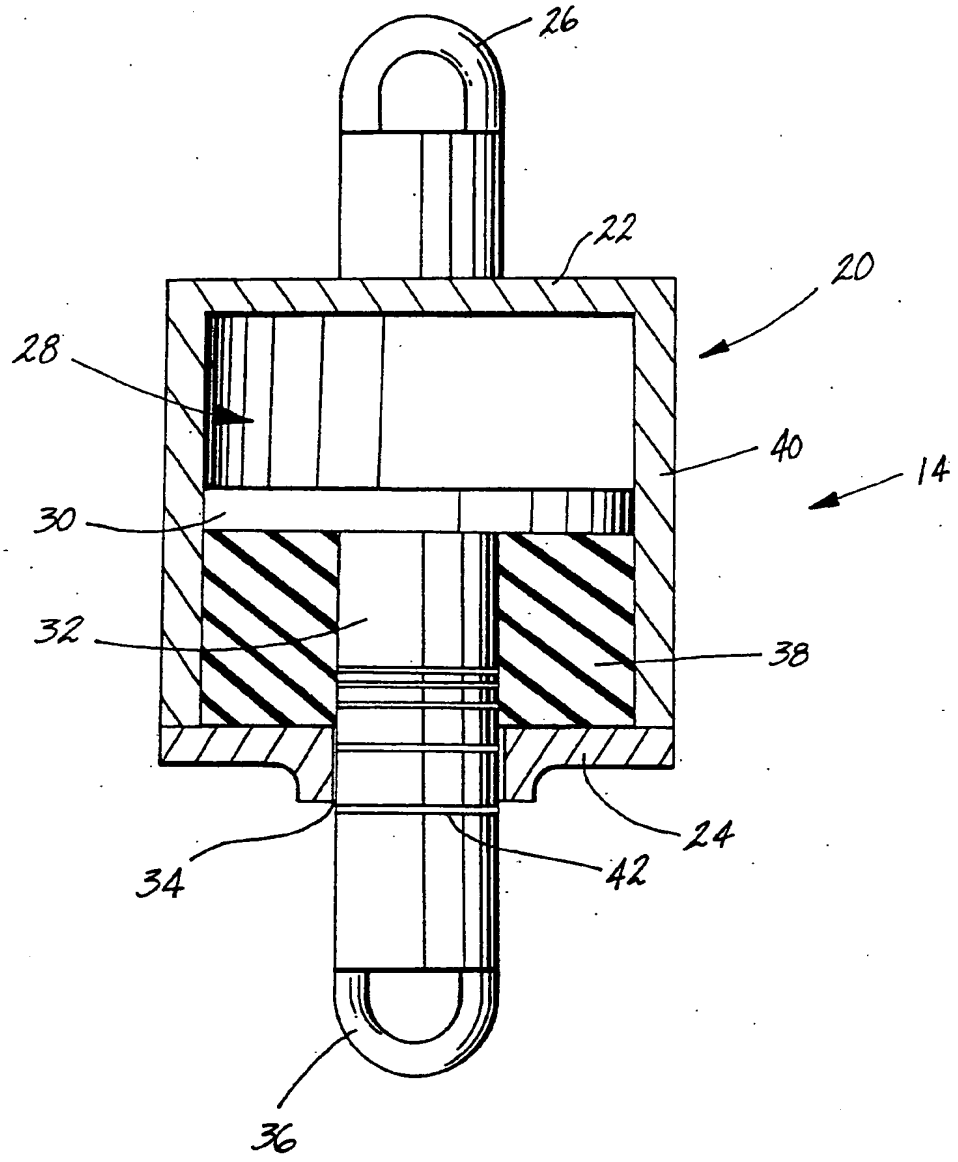

FIG. 2

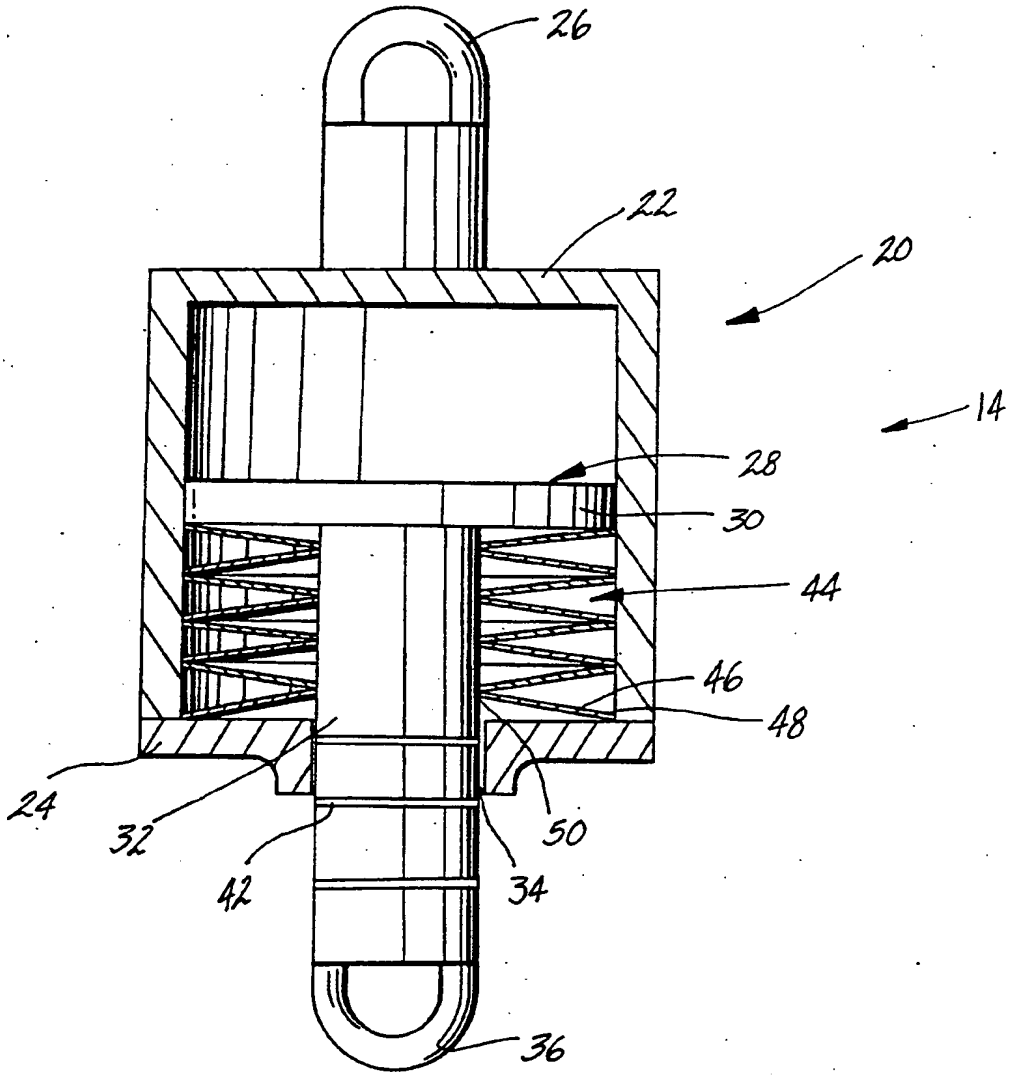

FIG. 3

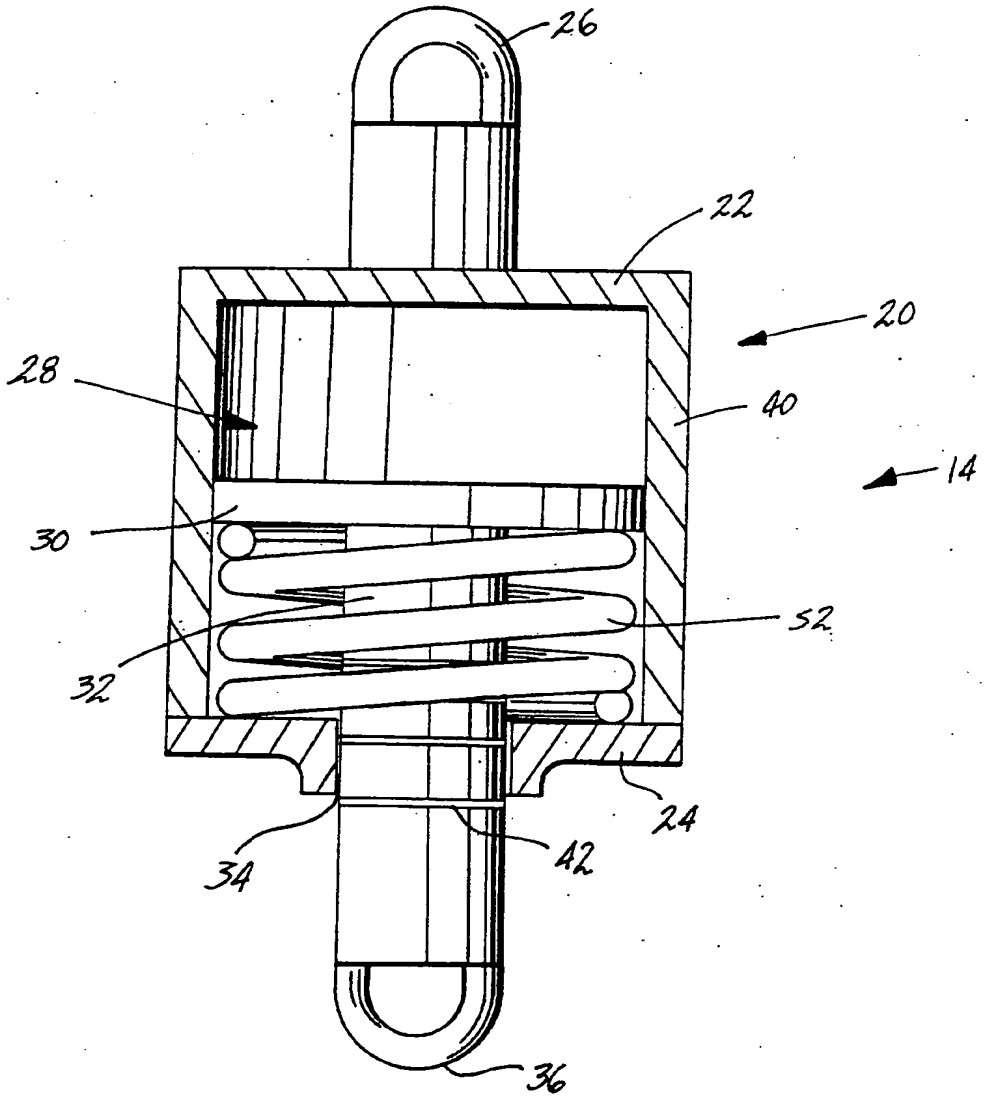

FIG. 4

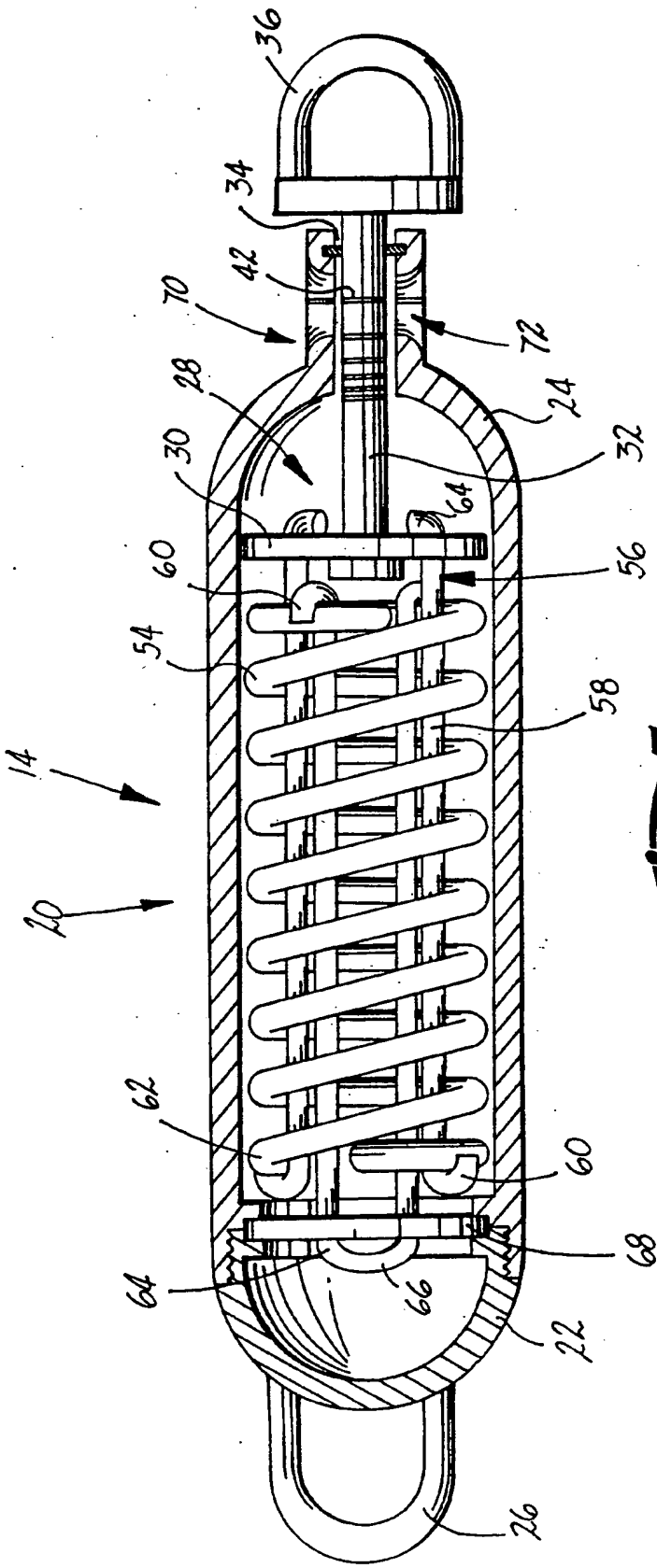

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/09119

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B60P 07/10; G01L 05/06
US CL :410/100, 23 73/862.392
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US,A 5,026,230 (Dolezych et al.) 25 June 1991 (see Figures 1, 12 and 13)	1-5, 6 --- 6
X	US,A 220,668 (Sawyer) 14 October 1879 (Fig. 1)	8
Y	US,A 2,227,870 (Thomas) 07 January 1941 (Figs. 7 and 8)	6
A	US,A 3,140,850 (Packard) 14 July 1964	none
A	US,A 2,024,444 (Friedlaender) 17 December 1935	none

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 October 1993	05 NOV 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer MICHAEL HUPPERT
Facsimile No. NOT APPLICABLE	Telephone No. (703) 308-1107

Form PCT/ISA/210 (second sheet)(July 1992)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/09119

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

I. Claims 1-7, drawn to a biased tether, classified in class 410, subclass 100;
II. Claim 8, drawn to a vehicle tie-down, classified in class 410, subclass 12.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/09119

B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.

410/10,11, 12, 23, 38, 100, 103
73/862.391, 862. 392, 862. 393, 862. 451, 862.56, 862. 621, 826
24/68 CD, 68CT, 68WT, 70CT, 69CT